Compression Device

The present invention relates to an inflatable compression device, in particular an inflatable compression device for improving arterial blood flow.

Existing inflatable compression devices for improving arterial blood flow comprise a wrap-around garment having inflatable bladders, the garment wrapped around a lower limb and the bladders inflated by a pump to apply pressure to the limb. Normally, the bladders are inflated rapidly at high pressure in order to empty the veins in the limb reducing the venous pressure, so that upon rapid deflation of the bladders, the reduced venous pressure results in an increased blood flow (hyperaemic response) in the arterial system.

Such inflatable compression devices are known to increase flow in the major blood vessels and over time, alleviate the symptoms of arterial disease, but are generally not comfortable for the user due to the use of rapid inflation at high pressures.

The present invention seeks to make improvements.

Accordingly, the present invention provides an inflatable compression device comprising a garment to encircle a limb, the garment having at least one bladder inflatable by a pump to apply pressure to a specific area of the limb covered by the garment, the garment further having means to warm substantially the whole of the limb covered by the garment. The combination of compression and warming is more efficient than systems that provide just compression alone, or warming alone. The device acts on the tissues at the site of compression, empties the veins, to promote a hyperaemic response in the arteries and so improves arterial flow. Over time, collateral flow in the diseased arteries is improved. The additional warming promotes flow to the superficial tissues by means

of vasodilatation of the arterioles and capillaries. This overall warming of the area augments and compliments the effects of the local compression and the overall effect is greater than using each method alone. Heating the tissues increases blood flow to the parts where ulcers and lesions occur and in doing so, help to cure them. The compression prevents the accumulation of the products of accelerated metabolism that may be promoted by warming, and by promoting hyperaemia ensures re-perfusion of oxygenated blood to tissue. Therefore, a combination of compression and warming improves significantly the general flow of fluids in the limb, both nutritional flow into the limb via the arteries and drainage of fluids at the lesions.

Preferably, the pressure applied to the limb is low and gradual, such that the compression device of the present invention operates at much lower pressures than existing compression devices. The gradual inflation of the bladder with warming is far more comfortable and better tolerated by the users, ensuring patient compliance. We have found that heating the whole area of the limb covered by the garment gave better blood flow measurements than heating only part of the limb. Furthermore, improved arterial flow was achieved with applying pressure to only specific areas of the limb covered by the garment resulting in a simpler garment requiring only a small bladder and better patient compliance. Advantageously, this combined compression and warming acts upon both systemic flow and superficial tissues at the same time.

In a preferred embodiment, the warming means includes an electrically heated flexible material forming an inner layer of the garment. Alternatively, the warming can be achieved by heating elements attached to an inner

layer of the garment. Other possibilities for the warming material include conductive polymers, carbon fibres, and foils. Preferably, the inner layer of the garment is joined together with an outer layer at their peripheries enclosing the bladder in between the layers, and more preferably both layers of the garment are vapour permeable to allow the transmission of sweat from the limb to the atmosphere.

The present invention is described by way of example below, with reference to the accompanying drawings in which:

Figure 1 is a schematic diagram of a preferred embodiment of the invention;

Figure 2 shows a cross-section of the garment in Figure 1 along X-X.

Referring to Figure 1, the device consists of a compression garment 1 that encircles a lower limb and is held in place with hook fasteners 2, although other means such as a zip, or even a slip on garment can be used.

The garment 1 has an air bladder 3 to apply pressure to a part, for example, the calf of a lower limb when inflated. The bladder 3 is made from flexible plastic film welded together to form an air tight enclosure with an integral supply hose 4. The bladder 3 is smaller than the garment and can take any form sufficient to compress only a specific area of the limb covered by the garment. The bladder 3 can be inflated to a pressure and time duration appropriate to the desired therapy by means of a pump (not shown) via hose 4. The bladder 3 is attached to the outer layer 6 of the garment.

The garment 1 also includes an inner layer of thermally transmissive material 5 to apply warming to the tissues (typically between 32 and 46 degree centigrade)

by passing an electrical current through the material 5. Possible materials include conductive polymers, carbon fibres, wire elements and foils. In another embodiment the inner layer 5 can be a material 5 housing electrical heating elements suitably insulated and extending the full area of the garment to provide heat to the whole circumference of the limb. The inner 5 and outer layers 6 of the garment are joined together at their peripheries enclosing the bladder 3 in between the layers. The outer layer 6 of the garment 1 is inextensible to provide effective compression of the limb upon inflation of the bladder such that as the bladder inflates it also imparts a reactive force to the encircling material which also compresses the limb.

Both the outer and inner layers 5, 6 are breathable to allow the transmission of water vapour and thereby avoid sweating of the limb.

We have found that a cycle of 60mmHg pressure compression for 10-12 seconds, followed by a decompression for 49 seconds allowing the venous system to refill, is the most effective in improving arterial flow. We have also found that that when compared to existing systems our protocol of a low pressure of 60mmHg for only 10-12 seconds is all that is needed to achieve a hyperaemic response and therefore increase arterial flow.

The present invention provides a compression garment that whilst applying low pressure to only part of a limb covered by the garment warms the whole area of the limb covered by the garment providing a more comfortable garment proven to improve arterial flow.